



Optimizing Future Work Zones in New England for Improved Safety and Mobility

AUTHORS: Yuanchang Xie, Nathan H. Gartner, Polichronis Stamatiadis, Tianzhu Ren, and Gustavo Salcedo, University of Massachusetts Lowell

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ABSTRACT

This research focuses on two critical factors that influence the mobility and safety of highway work zones: speed control and merge control. Among them, speed control is investigated using the Naturalistic Driving Study (NDS) data and an innovative Virtual Reality (VR) driving simulator. VISSIM and Surrogate Safety Assessment Model (SSAM) are utilized to evaluate various merge control strategies, including a New England Merge (NEM) proposed in this research. Additionally, a comprehensive review of existing speed and merge control methods is conducted.



DATA AND METHODOLOGY

This study innovatively utilizes the Naturalistic Driving Study (NDS) data for analyzing work zone crash and near-crash events characteristics, and generates useful insights into how crashes and near crashes develop and occur in work zones. It also develops and applies a Virtual Reality (VR) driving simulator to collect driver behavior data for investigating the effectiveness of various work zone speed control strategies. Additionally, this study proposes a New England Merge (NEM) control, which is compared to no control, early merge, late merge, and signalized merge based on VISSIM simulation and Surrogate Safety Assessment Model (SSAM) analysis. The proposed NEM can be readily implemented when all vehicles are connected and automated. Without connected and autonomous vehicles, this method is still practical given driver compliance and proper law enforcements, which are also required by the well-known early merge and late merge strategies that have been field implemented.



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RESULTS AND CONCLUSIONS

- The NDS crash data suggests that distraction is the most important endogenous factors contributing to work zone crashes and near crashes followed by fatigue driving and speeding. Stop-and-go traffic, sudden slowdown of lead vehicle, and unsafe merging maneuvers of vehicles in adjacent lanes are identified as top exogenous factors.
- The review of work zone traffic control plans shows that various forms of law enforcements are still the most effective but expensive means of controlling speeds in work zones. Dynamic speed display is also found to be effective and is less expensive to implement compared to law enforcements. The effectiveness of dynamic speed display is supported by the results of the VR driving simulation and a questionnaire conducted during the driving simulation study.
- The NEM control performs significantly better than no control, early merge, and late merge under medium to extremely heavy traffic conditions in terms of both safety and mobility. It also consistently outperforms signalized merge for all traffic demand levels.